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ABSTRACT

The three projects described in this paper were based on the intrinsic connection between language and the structure of perception and action. The first project explored the role of nonverbal frameworks in the development of communication between mother and child, beginning with the first word. It emphasized the role of the mother in the creation of the nonverbal context--action, objects, locations--that make early communication possible. The other projects investigated the relationship between the perception of information and semantic choice. One tested the role of information in semantic choice at the one-word stage (between one and two years of age), while the other explored the role of information at later stages of language development. (FL)

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Final Report to
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EXPLORATION OF COGNITIVE STRUCTURES COMMON TO BOTH LANGUAGE AND SENSORIMOTOR MODES OF BEHAVIOR

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Three major projects have been completed with funds from this grant. The basic theme underlying all three is the intrinsic connection between language and the structures of perception and action.

One project has explored the role of nonverbal frameworks in the development of communication between mother and child, beginning at the time of the first words. Emphasis here is on the role of the mother in the creation of the nonverbal context - actions, objects, locations, etc. --which makes early communication possible.

Two other projects have investigated the relationship between the perception of information and semantic choice. One of these was an experimental test of the role of information in semantic choice at the one-word stage (between one and two years of age). The other, also experimental, explored the role of information at later stages of language development. The basic hypothesis of these two studies is that the elements in the message which are relatively certain from the nonverbal context tend to go unstated, while those that are relatively uncertain tend to be expressed linguistically. Here, we use the terms certainty and uncertainty as they are used in information theory. That is, a nonverbal element is totally certain when it is the unique possibility in the situation. It becomes relatively more uncertain as the number of alternatives it must be selected from increases. Thus, uncertainty lies in the alternatives perceived in the context, and messages are informative to the extent that they allow selection of the element referred to by the linguistic encoding.

All three of these projects utilized the facilities of the video laboratory, set up with funds from this grant. As these facilities were described in detail

in the progress report of July, 1976, they will not be discussed here, except to note that their great flexibility continues to make them extremely useful for a wide variety of research.

Each project will now be described in turn. Finally, a bibliographical section will detail plans for publication and oral dissemination of results.

Making the Absent Present:
Facilitating Successful Communication in the One-word Period

When children do not respond appropriately to the talk that is directed to them, what work do caregivers do to make the interaction successful? Our study of the development of communicative interaction in the one-word period carried out in collaboration with Patricia Zukow and Judy Reilly, was directed toward answering this question. "Offer" sequences were selected as the interactional context to be analyzed and were characterized in the following way: (1a) caregiver presents topic of offer; (1b) child acknowledges offer affirmatively or negatively; (2a) (if the acknowledgement is affirmative) the caregiver facilitates the consummation of the offer; (2b) child accepts or rejects the offer.

On the basis of diary evidence, six children were selected for this study who were at varying levels of development within the one-word period. Naturalistic videotapes were made in the home. Analyses of the offer sequences were based upon repeated viewings of the tapes and a transcription system devised to integrate verbal and nonverbal information. Verbal and nonverbal initiated offer sequences were classified as Transfer Offers ("Do you want more milk?") or as Participatory Offers ("Do you want to play with the ball?"). The degree of success of these interactions was analyzed in terms of the work performed by the participants to create the shared context upon which successful

communication depends.

The results support the following general trends: For an offer to be successful for Stage I children, all elements need be tangibly present. Some of these elements of an offer are: appropriate location, objects, actors, and demonstration of the activity. Stage II acts as a transition. For the simpler offers (Transfer Offers), the offer can be successful with some elements absent from the nonverbal situation. However, for the more complex offers (Participatory Offers) all elements usually need to be present on a sensorimotor level. By Stage III, the children can respond to either type of offer without any additional non-verbal support. At the initial stage, the burden of concretely supplying all necessary elements for a specific interaction falls on the caregiver. As the child's symbolization capabilities increase, the responsibility for supplying some elements subtly shifts to the child, first on a sensorimotor level, then on the level of symbolic representation.

An Experimental Approach to the Psychogenesis of Presupposition

In an earlier paper (Greenfield, in press), we proposed that the distinction between information and certainty is the psychological basis for the distinction between assertion and presupposition in language. In philosophy of language, Stalnaker sees assertions or statements as functioning to partition alternatives that "are considered live options in the context" (Stalnaker, 1972, p. 388). On the other side of the coin, he views what can be taken for granted as going unstated. Stalnaker's analysis is most compatible with our idea, put forth elsewhere (Greenfield, in press), that the state of certainty or the process of taking for granted is the cognitive basis for presupposition, while

perception of uncertainty or change is the cognitive basis for assertion.

Uncertainty exists where there are possible alternatives; that element among possible alternatives which reduces uncertainty the most is considered to be the most informative. In our earlier work (Greenfield and Smith, 1976; Greenfield, in press) we have argued that the principle of informativeness can generally explain which element is selected for verbal expression. But information must be defined from the child-speaker's point of view. Uncertainty in this sense, then, is relative to the child. In order to validate the nature of the child's point of view, we must construct hypotheses about how the child structures situations in terms of the distribution of information and certainty and see if these hypotheses are borne out by the facts of semantic choice in these different sorts of situations.

Up to now, we have formulated hypotheses ex post facto which are validated by regularities in naturally-occurring speech samples. For example, in positive volitional utterances, i.e., where the child wants something, uncertainty lies with the volitional object, and this is the element generally expressed. In negative volitional utterances in contrast, the child is generally being offered something which he does not want. In such cases, the identity of the volitional object is taken for granted and volition itself (i.e., rejection) is expressed verbally (Greenfield and Smith, 1976). Thus a child would say banana (expression of volitional object) while reaching for a banana which she wanted to eat, but would say no (expression of negative volition) pushing away a banana offered by an adult, which she did not want to eat. Conversely, expression of the volitional element in a positive demand is uncommon

(e.g., saying want while reaching for a banana), while expression of a rejected object in a negative volitional utterance is also unusual (e.g., saying banana while pushing it away). Another manifestation of the principle of informativeness was the rarity with which agents were expressed and the nature of the unusual circumstances in which they were. Agents seem to receive verbal expression only when (a) there is conflict over agency, a question in the child's mind as to who should perform some action; or (b) an agent is not visibly present, as when the child hears someone making noise in the next room. These two types of situations constitute curcumstances under which agent uncertainty is maximized. In other types of situations involving intransitive action performed by an agent, it is often clear who is acting and uncertainty lies with the nature of the action. This is of course particularly true when the agent is the child-speaker; in this case the agent is maximally certain to the point of being totally taken for granted. Another application of the concept of informativeness to our naturally-occurring longitudinal data related to transitive action. Objects are expressed when the object is undergoing a change of state out of hand, while change of state is verbalized when the child is talking about an object in hand that he is acting upon (an idea put forth originally by Veneziano, 1973). Finally, we posited that when, in a sequence of events, all elements remain constand but one, the variable element has the highest information value and will be expressed. In this type of situation, alternatives are made available through change over time, permutations of the event are created by substituting one element for another. For instance, a child who has just taken off a shoe and is now taking off a sock should prefer to say sock rather than off, thus focusing linguistically

on the variable element. Although our original study did not include the proper sort of data to test this prediction, we did find some confirmation of this idea in a reanalysis of Bloom's (1973) data (Greenfield and Smith, 1976).

The purposes of this study, carried out in collaboration with Patricia Zukow, were (1) to formulate, before the data were collected, an expanded set of explicit hypotheses that predict the elements that children select to express, and (2) to produce the predicted semantic choices through experimental manipulation of the referential situation. These purposes were realized through the design of individualized experiments. The individualized experiment is a methodological innovation that deals with the widely recognized problem (e.g., Mischel, 1977) that the same physical stimuli may not be functionally equivalent for all participants in a given experiment. The basic concept is that what is held constant across subjects is not the physical characteristics of the stimuli but the functional relations between stubject and stimuli. In this study, the important functional relationships between child-participants and stimuli were the following: 1) The items relevant to a particular procedure had to be in the participant's lexicon; 2) the participant must have used a particular lexical item in reference to the physical stimuli actually used in the experiment; 3) the participant must have shown evidence of the ability to express, in single-word utterances, all the semantic functions assumed by the procedures; 4) the experimenter and surroundings must be maximally familiar to the participant (to achieve this aim, the mother served as experimenter and the experiment was carried out in the child's home). Each of the children in our sample had in fact a different lexicon, used lexical items in reference to different people, actions, and things, had a

slightly different set of semantic functions available, and lived in different physical and social environments. Maintenance of uniform functional relations across children required a different experimental procedure for each child: the individualized experiment.

This notion was actualized by designing a script for each child based on his or her actual vocabulary and word use. The script was designed in each case to test predictions about linguistic realization based on the informational characteristics of the referential situation: the general predictive principle was that the child would linguistically realize the most informative or uncertain element in the referential situation. A part of one of the scripts with the accompanying predictive rules is presented below; this sample shows how the general principle could be applied to particular types of concrete referential situation.

Scripted Action Speech	Applicable Rule	Semantic Prediction	Semantic Alternative
1) Constant action, variable object			
(When Alice comes in from outside) Can you take your hat off?	Rule 2	Action off	Object hat
Can you take your jacket off?	Rule 10	Object jacket	Action/State off
Can you take your shoes off?	Rule 10	Object shoes	Action/State off
Can you take your socks off?	Rule 10	Object socks	Action/State off

(Rules 2 and 10 are presented on the next page)

Rule 2 (applicable to transitive events)

When an object is in the speaker's possession or is being acted upon by the speaker, it is generally taken for granted through its connection with the self; its identity is not in question; and it will therefore go unexpressed. When the object is being acted on, uncertainty will inhere in the change of state, which will be expressed.

Rule 10 (applicable to subsequent events in an event sequence)

If, in a sequence of events, the action (including locative action) remains constant while the object varies, the object will be given verbal expression.

The sample was composed of four children who were part of a larger longitudinal group of babies recruited through a private pediatric practice in Los Angeles. Parents of each baby were shown how to keep a diary of the child's language development and were given diary forms to help them in doing so. The caretakers were interviewed a week prior to the videotaping to ascertain if there was evidence for the use of at least two alternative semantic functions in particular situations proposed for the script. At that time, possible lexical realizations for each semantic category were collected. A script was designed for each child on the basis of this information.

The basic method was selective imitation. That is, the mother as experimenter would follow the script, carrying out certain actions and describing them verbally or asking the child to do various things. The child's verbal expression would consist in selectively imitating some aspect of the mother's utterance. The use of imitation as an experimental technique is based on Piaget's basic discovery that imitation, far from being a mechanical procedure, reflects as much about the cognitive structure of the imitator as it does about

the characteristics of the model.

The principle of informativeness predicted and postdicted the actual semantic choices of all four children in the great majority of cases. Table 1 presents a summary of these data. Only the first verbal response to a referential event or adult utterance was counted for uprpose of these statistics, since the probability of expressing an alternative aspect of an event rises once a given aspect has already been expressed. Later responses to a given event were included in the qualitative examples to be described later, but they did not enter into the statistical analysis. (See Table 1, next page) Each child's data were subjected to a binomial test to see if the proportion of successful pre- and postdictions was greater than what would be expected by chance.

The chance probability of a correct prediction was considered to be .5 for purposes of the tests. This assumption leads to very conservative tests as the predicted choice is often one of three alternative types of semantic possibilities for each type of referential situation (e.g., a choice from among three elements: agent, action, or object).

The binomial test yielded clearly statistically significant results for three of the children and borderling results for the fourth (Table 1). Results for all four children are in the predicted direction. Exact probability levels are presented in the table. As Table 1 shows, most children did not follow the script frequently enough to permit separate analyses of the scripted behavior. In addition, several rules were formulated after the data had been collected. If we elminate unscripted behavior and ex post facto rules, only Jason provides a body of data large enough to test the purely predictive power of the rules. There are eight examples where Jason followed the script and the script tested

TABLE 1

Frequency of Scripted and Unscripted Confirmations and Disconfirmations of Specific Predictive Rules of Informativeness

Child	Alice		Jim		Jason		Martha	
	Scripted confirmation	Scripted disconfirmation	Scripted confirmation	Scripted disconfirmation	Scripted confirmation	Scripted disconfirmation	Scripted confirmation	Scripted disconfirmation
Frequency	2	2	5	0	11	0	1	0
	1, rule 10 1, rule 12	1, rule 2 1, rule 3	3, rule 2 1, rule 8 1, rule 11		2, rule 2 2, rule 3 1, rule 8 4. rule 10 1, rule 11 1, rule 14		1, rule 10	
	Unscripted confirmation	Unscripted disconfirmation	Unscripted confirmation	Unscripted disconfirmation	Unscripted confirmation	Unscripted disconfirmation	Unscripted confirmation	Unscripted disconfirmation
Frequency	8	0	3	0	9	3	7	2
	4, rule 2 2, rule 4 2, rule 11		1, rule 2 2, rule 11		5, rule 2 3, rule 4 1, rule 10	2, rule 2 1, rule 10	1, rule 2 1, rule 4 1, rule 5 4, rule 6	1, rule 1 1, rule 2
Total	10	2	8	0	20	3	8	2
p value	p=.019		p=.004		p=.001		p=.055	

rules formulated in advance. In all such cases, the predictions were confirmed by Jason's actual semantic choices. According to the binomial test, the probability of these results for Jason occurring by chance is less than .001. In the case of this one child, rules generated by the principle of informativeness enabled us to predict quite exactly what he would say when. In the case of the other 3 children, for whom postdiction was necessary, it would be more accurate to conclude that these same rules allow us to understand their semantic choices in the great majority of instances.

An example will show how the rules derived from the principle of informativeness manifest themselves in actual behavior. A part of an actual protocol with the applicable rules is presented below:

Mother	Jason	Applicable Rule
Mother putting jacket on.	Jason is looking at and approaching his mother.	
Look Mommy's putting jacket on		
	[dʒæ kʌt] jacket/	Rule 1
	[dʒæ:: kʌt] jacket/	Rule 7
	[dʒæ:: kʌt] jacket/	Rule 7
((Barely audible)) Mm hm/		
	[dʒækʌ:t] jacket/	Rule 7
Here the ja:cket's o:n/		
	[ɑn] on/	Rule 9
Mother taking jacket off.		
Now Mommy's taking the jacket off.		
	[ɔ:f] off/	Rule 11

Rule 1 (applicable to transitive events): When an agent is making an object undergo a change of state at a distance from the speaker, perception of that event is likely to involve a shift of focus to the object in question. The identity of the object is uncertain. Hence the object becomes a topic that is not taken for granted and will therefore, be expressed.

Rule 7 (applicable to all events): If the most uncertain and informative element within a single referential event is unsuccessfully expressed, it remains uncertain and informative. Therefore, if the child continues to encode the situation verbally, he will persist in encoding that element until successful or the situation changes.

Rule 9 (applicable to all events): Once the most uncertain or informative element in a single referential event involving two elements has been given verbal expression, it becomes more certain and less informative. At this point, then, if the child continues to encode the situation verbally, he will now express the other aspect, heretofore unstated.

Rule 11 (applicable to subsequent events in an event sequence): If, in a sequence of events, the object remains constant while the action varies, the action will be given verbal expression.

In the above exchange, the child starts by naming the object undergoing a change of state at a distance (Rule 1). Unsuccessful utterances are repeated until the utterance is acknowledged (Rule 7). Mm hm does not acknowledge "what" was said only that "something" was said. When the mother expands the child's prior utterance, thereby acknowledging that utterance, Alice goes on to encode the next most informative element (Rule 9). In the next referential event the object remains constant while a further change of state occurs. This change is expressed (off, Rule 11).

From inferences made about the child's view of the referential situation, we were able to account for a large proportion of the children's utterances. Central to our argument was the notion that the distinction between information and certainty is the psychological basis for the distinction between assertion and presupposition in language. That which is presupposed, taken for granted, is more certain and less informative and, therefore, left unexpressed or expressed later. The uncertain, changing, informative elements are expressed first. The notion of informativeness has extended our ability to predict what

children say when they speak and appears to hold promise for increasing our knowledge of the relationship between cognition and communication.

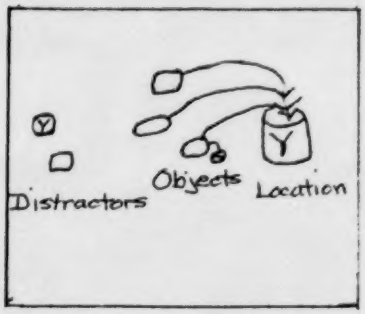
A Developmental Study of the Communication of Meaning: The Role of Uncertainty and Information

This study extended the exploration of the relation of informativeness to older children communicating about complex action sequences.

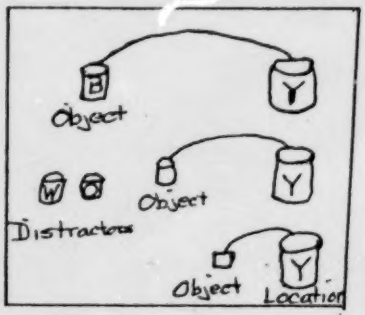
The basic method involved having children of two ages -- six and ten years old -- describe a series of complex construction tasks to an adult who had the same set of materials, but who could not see the child's action. Half described their own construction activity while the other half described the same activity performed by a second adult seated next to the child (activity variable). Half of the children in each of the above conditions described the activity while the action was going on and the other half described it after it had been completed (time of description variable). The goal, which was held constant in all conditions, was to describe what he or she was doing so that the adult could construct the same thing as the child. Each child described manipulations of a set of structured materials (beads and cup, seriated cups). There were three construction tasks of differing structure (task structure variable).

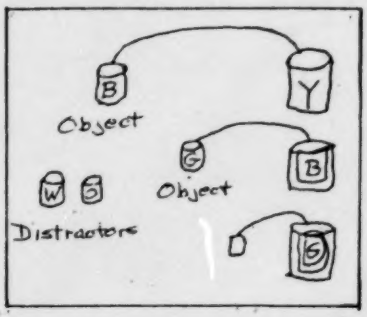
The three tasks are presented in Figure 1.

Task 1. Beads in Cup: Pot method with equivalent objects.



Task 2. Seriating Cups: Pot method with nonequivalent objects.
View a: Location unchanging across actions. View b: Location changing across actions.





Task 3. Seriating Cups: Subassembly method with nonequivalent objects.

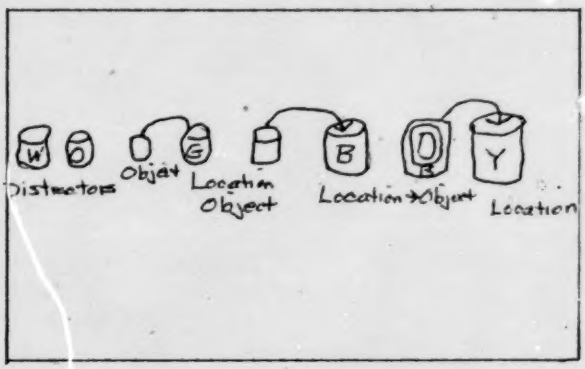


Figure 1. Action roles and relations in construction tasks. B=blue; Y=yellow; W=white; O=orange; G=green; R=red.

The audio tapes of the children's descriptions were transcribed, and these transcriptions were scored for expression of action elements belonging to the following categories: Agent (Ag), Object (O), Location (L), Action-Process (AP), Temporal State (TS), Property of Object (PO), Locative State (LS), Property of Location (PL). The categories are defined as follows:

Arguments

Agent (Ag) - animate initiator of action-process

Object (O) - inanimate entity affected by the action-process

Location (L) - location or spatial orientation of the action-process

Predicates

Action-Process (AP) - action which is performed by the agent and affects the object

Temporal State (TS) - modifier of action which indicates sequencing of action

Property of Object (PO) - state or condition of object

Locative State (LS) - state of object which results fromlocative action-process

Property of Location (PL) - state or condition of location

The application of these categories to the linguistic productions in the present study were derived from an "ideal" (aximally complete) description of the actions (see Table 2).

Table 2. Propositional categories used for coding expression of elements.

TASK		Coding of Maximally Complete Descriptions									
		TS	Ag	AP		PO	O	LS		PL	L
Beads:	Pot method	First,	I	put	the	blue	bead	in	the	yellow	cup.
		Then,	I	put	the	green	bead	in	the	yellow	cup.
		Then,	I	put	the	red	bead	in	the	yellow	cup.
Cups:	Pot method	First,	I	put	the	blue	cup	in	the	yellow	cup.
		Then,	I	put	the	green	cup	in	the	blue	cup.
		Then,	I	put	the	red	cup	in	the	green	cup.
Cups:	Subassembly method	First,	I	put	the	red	cup	in	the	green	cup.
		Then,	I	put	the	green	cup	in	the	blue	cup.
		Then,	I	put	the	blue	cup	in	the	yellow	cup.

Type of propositional element: Temporal State (TS), Agent (Ag), Action-Process (AP), Property of Object (PO), Object (O), Locative State (LS), Property of Location (PL), Location (L)

The encoding scores are based on the ratio of each element to the total number of combinatorial actions linquistically referred to by the child. A combinatorial action was defined as the putting together of two items from the array of materials, e.g., placing a bead in the cup (Task 1).

A repeated measures analysis of variance (ANOVA) was performed on these scores in order to ascertain how much of the variance in the scores was due to the effects of age, treatment conditions, and task structure. The propositional categorization of action was used as the repeated factor in the design so that a relatively detailed analysis could be made of the effect of within-task structure on linguistic encoding. Thus, the design was a 2(age)X2(activity)X2(time)X3(task) X8(action element) factorial design with repeated measures. The significant main effects and interactions are given in Table 3.

Table 3. Results of the analysis of variance

Source of Variance	F	Corrected Probability Level
Age	4.22	p = .043
Task	17.77	p .001
Type of action element	106.78	p .001
Time of description X type of action element	6.13	p .001
Task X type of action element	26.92	p .001
Task X age X type of action element	2.52	p .025

The results were interpreted in terms of an analysis of the tasks based on uncertainty. Uncertainty arises when there are alternative entities to choose from or when entities or reltations are changing. Thus, we analyzed the tasks in terms of when the entities (arguments) and relations (predicates) occurred in sets of alternatives at one point in time or changed as the task progressed. A summary of this analysis is shown in Table 4 and explained below. First, features common to all three tasks, and then features specific to each will be taken up and analyzed with respect to uncertainty. (Reference to Figure 1 will probably be necessary to understand the analysis that follows.)

Table 4. Loci of uncertainty in each task.

	Alternatives Within Each Action	Change Across Actions
Task 1. Beads: Pot method		
Arguments	Agent (?)	Property of Object
Predicates	Action-Process Property of Object Locative State	
Task 2. (View a), Cups: Pot method		
Arguments	Agent (?)	
Predicates	Action-Process Property of Object Locative State	Property of Object Temporal State
Task 2. (View b), Cups: Pot method		
Arguments	Agent (?)	
Predicates	Action-Process Property of Object Locative State	Property of Object Property of Location Temporal State
Task 3. Cups: Subassembly method		
Arguments	Agent (?)	
Predicates	Action-Process Property of Object Property of Location Locative State	Property of Object Property of Location Temporal State

Table 4 shows the patterns of uncertainty in the task analyzed for alternatives within each action and change across actions, the two basic types of uncertainty. Uncertainty about what is to be done (Action-Process) and the resultant relations among the materials (Locative State) exists within each action for all three tasks. That is, there are a range of possibilities for manipulating the materials. However, Action-Process and Locative State remain constant from action to action within a given task. From the speaker's perspective, the initial uncertainty about Action-Process and Locative State is exaggerated for the listener who, the speaker has been told, cannot see what is being done to the materials. Agent is, in one sense, relatively certain both within and across actions; that is, who will be performing the actions is specified in the initial

instructions and does not vary from action to action. In another sense, Agent is uncertain within an action, for there exist three potential Agents within the experimental situation, the child and the two experimenters. For this reason, Agent appears in the table with question marks next to it.

In Task 1, the beads task (Figure 1), the Agent must first select a bead rather than a cup. Therefore, the nature of the Object has some degree of uncertainty. However, encoding the Object with a noun ("bead") would be uninformative because it does not partition the alternative Objects, all of which are beads. The informative element is the Property of Object, because color or shape differentiates the subset of Object beads from the distractors. Property of Object appears as uncertain in the left-hand column (alternatives within each action) because a bead must be selected from alternative possibilities on each move. Property of Object also appears in the right-hand column (change across actions) because a different Object must be selected for each move (Figure 1). Location is, in contrast to Object, relatively certain, for the cup is, practically speaking, a unique Location for the beads. Because there is only one cup in the array, there is no uncertainty about any Property of Location; all properties are determined once the nature of the Location as a cup is known. Since the beads can be placed in any order, Temporal State of the actions is not a relevant variable.

Task 2, seriation of cups by the pot method (Figure 1), differs in that the materials contain only one type of entity (argument), cups. For this reason, the nature of both Objects and Locations is totally certain. As in Task 1, uncertainty lies in the Property of the Object because a particular cup must be chosen as an Object for each move and because Property varies across actions.

Unlike Task 1, a particular order of placement (from largest to smallest) is required to complete the task (seriate the cups). Therefore, Temporal State is a relevant variable. (Although some children probably interpreted the modeled order in Task 1 as relevant, order would, overall, have been less salient than for the seriation tasks (2 & 3).) Within an action, Property of Location is never uncertain because once the Locative relation (inside of) has been specified and the Object selected, there is only one possible Location in which that Object could fit (see Figure 2). In the simpler view of Task 2, view a, the task can be seen as placing a series of cups in the largest yellow cup. Because the yellow cup is always seen as the Location, Property of Location does not vary across actions. The more complex view of the task (View b) involves seeing the last, not always the yellow, cup placed as the Location. Thus, this view produces an additional source of uncertainty: Location, distinguished by its color or size (Property) changes across actions.

The task which involves the most uncertainty is Task 3, seriation of cups by the subassembly method (see Figure 1). In this task cups are combined beginning with the smallest cup rather than the largest. Therefore, there not only exist alternatives of Property (color/size) for the Object of each action, but also alternatives of Location, identified by color or size (Property), since the smaller cups can fit into any of the larger ones. This was not true for the pot method of construction where the larger cups are placed first. As with the pot method, order (Temporal State) is a relevant variable across actions because of the constraints of seriation. The Properties of both Objects and Locations also change across actions.

This analysis shows an increasing degree of uncertainty from Task 1 to Task 2 (on either view) to Task 3. These patterns of uncertainty should lead to certain patterns of verbal encoding when actions are described. It was hypothesized that uncertain rather than certain elements would be verbally encoded. The resulting linguistic descriptions would thus be informative in partitioning the alternatives existing for speaker and listener communicating about a particular task structure. In general, it was expected that within-action uncertainty would produce linguistic encoding of a particular element for the first action in a task sequence, while between-action variability would motivate the continued encoding of an element during the second and third actions in a sequence. How particular patterns of information and certainty are reflected in specific types of linguistic productions are described below.

In general it was found that the descriptions of children of both ages were informative in that they tended to encode the more uncertain task elements: Property of Object, Property of Location, Action-Process and Locative State. These four elements were most frequently given verbal expression when type of action element was considered independently of the other factors. In addition, when task was considered independently, it was found that the number of elements verbally encoded increased as uncertainty increased across the three tasks.

The pattern of results is basically the same for both six and ten-year-olds. However, ten-year-olds generally encode more than six-year-olds. This tendency to encode more is particularly pronounced for the informative elements. Thus, in comparison to the descriptions of the six-year-olds, those of the ten-year-olds reflect to a greater extent patterns of information and certainty inherent in the structure of a complex task. This is evidence that ten-year-olds are better

at discerning elements which are important when constructing a message for the purpose of communication.

A final factor which affects the verbal encoding of a messa ge is the time of description relative to the action described. Elements which are not perceptually present to the speaker after the action has been completed (Temporal State, Agent and Action-Process) are encoded more often in the post condition than in the simultaneous condition where they are perceptually present. Elements which are not as perceptually obvious during action (Locative State and Property of Location) as after the action has been completed are, in contrast, encoded more when descrition is simultaneous with action. Thus, time of description affects the linguistic message by changing the relative certainty of the various task elements for the speaker.

These results reveal that perception of uncertainty is a general cognitive process influencing linguistic realization even at relatively advanced stages of language development. As such, it is a motivating force behind the use of mature syntactic forms such as ellipsis and conjunction. On a more general level, this study is another demonstration of the intrinsic connection between linguistic structure and structure in other modes of cognition.

Plans for Publication and Dissemination of Results

The following chapters have been completed and are now in press:

P. M. Greenfield and P. G. Zukow, Why do children say what they say when they say it?: An experimental approach to the psychogenesis of presupposition. In K. Nelson (Ed.), Children's language, Vol. 1. New York: Gardner Press.

P. M. Greenfield and C. Dent, A developmental study of the communication of meaning: The role of uncertainty and information. In P. French (Ed.), The development of meaning, Japan: Bunka Hyoron Press

The above chapters stem from the second and third projects described in the body of this report. A chapter stemming from the first project is almost complete; it will appear in Volume 2 of Children's Language, edited by Keith Nelson.

The following two abstracts have been submitted for presentation at the International Congress of Child Language, to take place in Tokyo:

J. Reilly, P.G. Zukow, and P.M. Greenfield, Making the absent present: Facilitating successful communication in the one-word period.

C.H. Dent and P. M. Greenfield, An experimental approach to the developmental study of pragmatic presupposition.

Three abstracts are being prepared for presentation at the Stanford Child Language Research this spring, one representing each of the three projects. In addition, new analyses from the work on early mother-child communication will form the basis for a chapter in a festschrift book for Jerome Bruner, edited by David Olson, while additional anayses from the study on the communication of meaning in older children will be the basis for a book on discourse and syntax to be edited by Talmy Givon. Finally, two copies of this report, along with the completed chapters, are being sent to the Educational Resources Information Center.

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